

ACTIVITY 3 GRADES 6-12

Objectives

Students will be familiar with the concept of biological diversity (biodiversity) and why it is important.

Students will describe how diversity can be measured and expressed with a mathematical index.

Students will understand how useful a non-biological model can be in describing biological processes.

Students will understand the effect an invasive species such as purple loosestrife can have on diversity in the biological community it invades.

Time Suggestion
45-minutes.

Wisconsin Model Environmental Education and Science Standards

Environmental Education:

A.8.1, A.8.4, A.8.5, A.8.3,
B.8.3, C.8.2, D.8.6, A.12.1,
B.12.3, B.12.6, B.12.7.

Science: C.8.2, C.8.3, C.8.11,
F.8.8, F.8.9, C.12.4, C.12.5.

BEAN BIODIVERSITY*

DESCRIPTION

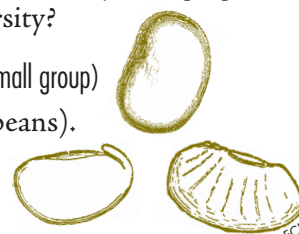
Students use an index model to assign numerical values to the biological diversity of a given habitat.

PROBLEM

How can various biotic communities (or a community changing over time) be compared in terms of biological diversity?

MATERIALS (To be distributed to each student or each small group)

- ☐ Several assorted, dry seeds (grocery store beans).
- ☐ Paper lunch bags.



PREPARATION

Prepare one bag with assorted seeds for each student or group of students. Each bag should contain 30 seeds of at least five different kinds (similar in size and shape). Read and discuss the background information with the students.

PROCEDURES

1. Each student or small group should get a paper bag of assorted seeds.
2. Assign a wetland plant name to each seed type, making sure to name one of the seeds purple loosestrife.
3. Ask students to begin removing seeds from their habitat bag, randomly, one at a time. Using letter symbols for wetland plant names, record your results. Remove 30 seeds. Results should look something like this: LLCCSJLL...
4. Have students calculate the Diversity Index of their habitat bag and record the number.

Diversity Index = number of runs/total number of plants (30)

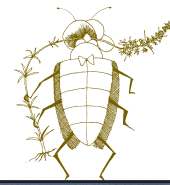
The number of runs is the number of groups of the same plant (seed type) found consecutively in your random drawing. Another way of stating the number of runs is that it is equal to the number of times that you encounter a change in the kind of plant seed as you move through the sequence. In order to determine the number of runs, draw a line above or below, in alternating fashion, each identical letter that appears consecutively, like this:

LLCCSJLL

In this example there are 5 runs for 8 plants.

Diversity Index = $5/8=0.625$





ACTIVITY 3 BEAN BIODIVERSITY (CONTINUED)

5. Each small group should be given additional purple loosestrife seeds. For every purple loosestrife seed added, randomly remove one of the other seeds, mimicking the displacement that is said to occur when purple loosestrife invades.
6. Repeat steps 3 and 4 and see how the diversity index changes.

BACKGROUND INFORMATION

One of the major problems with the increase of purple loosestrife in North American wetlands, often cited by researchers and resource managers, is that it tends to crowd out native wetland plants. If this happens, loosestrife becomes more important in the functioning of the community and many kinds of plants it replaces become less important in the system. Gradually the number of different kinds of plants in the wetland will fall as some of the least common or most sensitive native species are eliminated by the spreading loosestrife. The “diversity” of plants in the wetland is said to decline as there are more loosestrife plants, fewer native plants, and smaller numbers of the native species remaining in the wetland overall.

As plant diversity declines, the variety of available food for herbivores goes down, the kinds of places for wetland birds to nest declines, and so on. Consequently, the number and types of herbivores and birds and other animals dependent on native plants is reduced and the whole wetland community becomes less diverse. In extreme cases of very low biological diversity a wetland may become a “monoculture” (not unlike the bluegrass lawns around many of our homes). What do you think this expression means?

Biodiversity in a biotic community is a measure of the number of kinds of organisms, how evenly distributed they are, and how many of each there is in the community. It is a significant ecological concept because a diverse community is thought to be more stable and resistant to degradation in

spite of a changing world around it. Why do you think this is important today?

If it is true that purple loosestrife replaces wetland plants, and we have an accurate way of measuring and comparing diversity in wetlands over space or time, students should see a strong negative effect of increasing levels of purple loosestrife density on the diversity index: that is, as loosestrife increases, diversity decreases. If the expected relationship does not appear, it may not be true, or further research or refinement of techniques or calculations may be necessary.

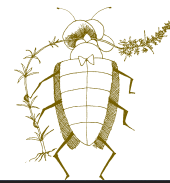
This activity uses a simple, non-biological model to measure diversity by calculating a mathematical diversity index for a group of items. It also allows us to see what happens as one of the items becomes more common in the group and the others less common. This mimics what would happen if purple loosestrife were indeed to replace other plants in a wetland. The number of runs (see procedures) is a measure of both how many different types of organisms there are, as well as the relative numbers of each, for a given number of organisms counted (sample size). The closer the diversity index is to 1, the more diverse the community is. Simply put, the more different kinds of species there are, the more even in number they are, and the more evenly they are distributed, the greater the diversity. Bear in mind that the number of items counted should be similar to be able to compare different communities in either space or time.

STUDENT ASSESSMENT

Have students write a lab report stating the problem, a hypothesis, experimental procedures, observations, analysis and conclusions. They should include a discussion of how well the model mimics what can happen in a wetland community as purple loosestrife invades.

EXTENSIONS

Re-work your calculations, excluding purple loosestrife runs (the increasing item) from the



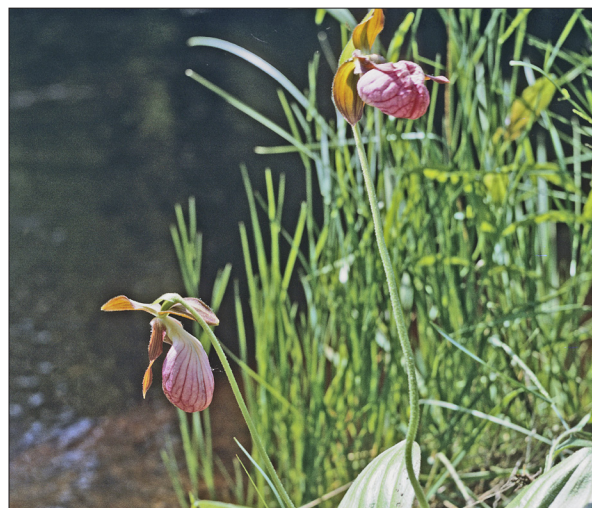
ACTIVITY 3 BEAN BIODIVERSITY (CONTINUED)

numerator of the diversity index. This will give you a measure of the effective diversity of only native plants. Is the resulting diversity index higher or lower than when you included loosestrife? Why? One might argue that this might be a more meaningful measure of plant diversity in native wetlands. Why is this so? Which means of calculating diversity is most meaningful for you? Why?

Sample the diversity in real wetlands. Tie a cord (transect line) to two posts put into the ground 3 meters apart in a wetland. Instead of randomly drawing seeds out of a bag, record the species identity of each plant as it is encountered along (under or over) the transect line. Calculate the Diversity Index for the wetland. Walk transects at several randomly chosen spots, being sure to use the same number of counted individuals each time. Does each transect give the same index value? Why or why not? Average them for a good overall value. (See also Activity 11. Wetlands on the Mend, page 34)

Using the information from the transects or model, determine the percent of each plant species encountered in each wetland by dividing the number of individuals of one species by the total number of individuals counted. This is a Species

Diversity Index. Does it tell you more or less about the diversity of the sampled wetland than the Diversity Index we calculated above? Show your results in a bar graph.



WISCONSIN WETLANDS ASSOCIATION

PHOTOS: WISCONSIN DNR

Healthy wetlands support diverse plant and animal communities like the ones shown here.

* Revised with permission from "The Spice of Life: Assessing Species Diversity" in *Biodiversity, Wetlands, and Biocontrol* and "Annual Wetland Plant Diversity Survey" in *The Purple Loosestrife Project Cooperator's Handbook*.